

Wiener index of the composition of two planar graphs

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Abstract—The Wiener index, is the first, and also one of the most important topological indices of chemical graphs. In addition to this, there are many situations in communication, facility location, cryptology, architecture etc, where the Wiener index of the corresponding graph or the average distance is of great interest. One of the problems, for example, is to find a spanning tree with minimum average distance. In this paper we are going to present the composition of two planar graphs, through some examples and, in the end, we going to focalize to calculate the Wiener index for the composition of two cycle planar graphs $W(C_{n_1} \circ C_{n_2})$ and the Wiener index for the composition of cycle planar graph and path planar graph $W(C_{n_1} \circ P_{n_2})$ using our's theorem.

Keywords: The corona two graphs, the cycle planar graph, index Wiener, the path planar graph.

I. INTRODUCTION

The first investigations into the Wiener index were made by Harold Wiener in 1947 who realized that there are correlations between the boiling points of paraffin and the structure of the molecules in particular. He mentions in his article that the boiling point t_B can be quite closely approximated by $t_B = aw + bp + c$, where w is the Wiener index, p the polarity number and a , b and c are constants for a given isomeric group. Since then it has become one of the most frequently used topological indices in chemistry, as molecules are usually modeled as undirected graphs, especially trees. For example, in the drug design process, the aim is the construction of chemical compounds with certain properties, which not only depend on the chemical formula but also strongly on the molecular structure, as one can easily see when considering cocaine and scopolamine, both having the chemical formula $C_{17}H_{21}NO_4$.

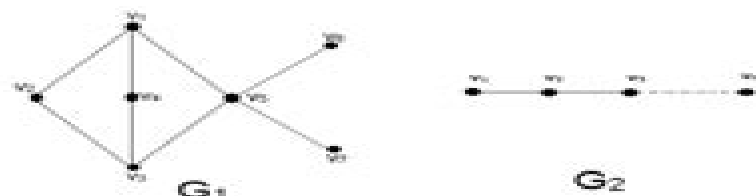
A graph G is a triplet consisting of a vertex set $V(G)$, an edge set $E(G)$, and a relation that associates with each edge two vertices called its endpoints. We denote $n = |V(G)|$ is the vertex number of G and $m = |E(G)|$ is the edges number of G . A path is a simple graph whose vertices can be ordered so that two vertices are adjacent if and only if they are consecutive in the list. A graph G is connected if each pair of the vertices in G belongs to a path. The degree of vertex v in a graph G , which is written $deg(v)$, is the number of edges

incident to v , except that each loop at v counts twice, and we call distance between two distinct vertices of graph G , u and v , the smallest length of a path between u and v in G . The diameter of G , denoted by $D(G)$, is defined as the maximum distance between any two vertices of G , that is, $D(G) = \max\{d(u, v) : \forall(u, v) \in V(G)^2\}$, we call $d_G(k)$ the number of pairs of vertices of G that are at distance k , note that $d_G(0)$ and $d_G(1)$ represent the number of vertices and edges, respectively. The Wiener index of the graph G equals to the sum of distances between all pairs of vertices of the respective molecular graph, i.e. $W(G) = \sum_{\{u,v\} \subseteq V(G)} d(u, v)$, and we define the index Wiener of a vertex u in the graph G as $w(u, G) = \sum_{v \in V(G)} d(u, v)$, for more information about Wiener index and its properties we can see [1,2,3,4].

II. THE COMPOSITION OF TWO GRAPHS

Starting from the 1970, the composition (the corona) of two graphs gained much popularity and, since then, new results related to it are constantly being reported. Mr Frucht and Harary in [5,6] gave the definition and some results for the composition of two graphs.

Let G_1 and G_2 be two graphs on disjoint sets of n_1 and n_2 vertices, respectively :



The composition $G_1 \circ G_2$ of G_1 and G_2 is defined as the graph obtained by taking one copy of G_1 and n_1 copies of G_2 , and then joining i^{th} vertex of G_1 to every vertex in the i^{th} copy of G_2 (see Fig. 1)[5,6,7].

Wiener Index Of A Graph And Chemical Applications

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